Hybrid Rydberg atom-photon-superconductor quantum interface

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Wisconsin 53706 — Hybrid quantum computation exploits the unique strengths of
disparate quantum technologies, enabling realization of a scalable quantum device
capable of both fast gates and long coherence times. We propose a quantum inter-
face for creating hybrid entanglement between neutral atom and superconducting
qubits. The interface is mediated by coupling superconducting qubits to microwave
photons, and microwaves to Rydberg excited single atoms using chip-based coplanar
waveguide microwave cavities. We have developed a simple gate scheme to enable
entanglement of an atomic qubit with a microwave photon, with fidelity calculations
based on realistic parameters giving Bell-state preparation fidelity exceeding 0.999
on μs timescales [1]. Experimental progress towards the coherent excitation of a
single atom above a coplanar waveguide in a 4 K cryostat will be presented.

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